

Analysis of Near Surface Circulation of the Japan East Sea

Pearn P. Niiler
Scripps Institution of Oceanography
9500 Gilman Drive
MC 0213
La Jolla, CA 92093

Phone: (858) 534-0378 fax: (858) 534-7931 email: pniiler@ucsd.edu

Dong-Kyu Lee
Department of Marine Sciences, Pusan National University
Busan, 609-735, Korea
Phone: (51)510-2180 Fax: (51)581-2963 email: lee@po.ocean.pusan.ac.kr

N00014-98-1-0235

LONG TERM GOALS

The long-term goal is to study the variability of the upper ocean current systems and their relationship to meteorological forcing. To this end, spatially coherent field observations are required of the ocean response and the atmospheric forcing. A new instrument, the MINIMET, a water following drifter, was designed as a tool to obtain ocean and atmospheric data. Arrays of MINIMETS will be utilized in a coordinated field experiment in marginal seas to study wind-driven ocean currents.

OBJECTIVES

The scientific objectives are to obtain direct measurements of ocean circulation on various time and space scales that are of sufficient spatial density and time duration so both seasonal means and intra-seasonal variations can be determined. This data will be used to test model dynamics, both in the processes that determine the mean motions, as well as the exchange of energy and momentum between the mean and eddies. A comparison of the MINIMET observations of the circulation field and wind field with models and satellite observations will be made.

APPROACH

In marginal seas, circulation patterns are spatially complex and seasonably variable. Lagrangian techniques are well suited for developing quantitative estimates of the circulation in the areas where the general pattern of currents are not well known. Wind fields are complex, often affected by mountains or other land boundaries. Large numbers of drifters were deployed from volunteer ships in the Japan-East Sea to map the circulation patterns. In the period of 1998-2001 we released 56 MINIMETs and 33 SVP drifters from VOS and research vessels. Data from the NASA/QuikSCAT was used for verification of the wind observations.

Report Documentation Page			Form Approved OMB No. 0704-0188	
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>				
1. REPORT DATE 30 SEP 2002	2. REPORT TYPE	3. DATES COVERED 00-00-2002 to 00-00-2002		
4. TITLE AND SUBTITLE Analysis of Near Surface Circulation of the Japan East Sea			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Scripps Institution of Oceanography,,9500 Gilman Drive,MC 0213,,La Jolla,,CA, 92093			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT <p>The long-term goal is to study the variability of the upper ocean current systems and their relationship to meteorological forcing. To this end, spatially coherent field observations are required of the ocean response and the atmospheric forcing. A new instrument, the MINIMET, a water following drifter, was designed as a tool to obtain ocean and atmospheric data. Arrays of MINIMETS will be utilized in a coordinated field experiment in marginal seas to study wind-driven ocean currents.</p>				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF: a REPORT b ABSTRACT c THIS PAGE unclassified unclassified unclassified			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 7
			19a. NAME OF RESPONSIBLE PERSON	

WORK COMPLETED

Data processing has been completed from a uniform format from a suite of 131 SVP, 44 MINIMET and 72 NAVY drifters. Data from QuikSCAT has been interpolated on to the drifter tracks and the co-located data has been analyzed. Numerical model data from 0.1 degree global model has been accessed and is under investigation. The analysis of East Sea drifter data has been completed.

A mooring technique for drifting buoys was designed and implemented for the littoral zone (Figure 3). A mooring was successfully deployed in coastal waters off South Korea. After six days in the water, a typhoon with 85KNT winds passed over it. The mooring and the data system survived the typhoon, but it was cut loose by illegal fishing activity. It has since been recovered and will be re-deployed.

RESULTS

Analysis:

Joint analysis of historical temperature and frontal location data relative to drifters has been completed (Figure 1). Computations of energy exchange between mean circulation and mesoscale in the warm water have been completed using Lagrangian techniques (Figure 2). A paper on the compilation of all of the drifter observations will be completed and submitted for publication in October 2002.

Mooring:

The successful deployment of a moored “drifting buoy” during a typhoon yielded time series of winds, temperature at 10 depths, near bottom salinity and 5 channels of ocean color in frequencies where biological activity is expected. In addition to yielding valuable data this short-term deployment demonstrated the viability of mooring thermistor chain equipped drifters in coastal waters.

IMPACT/APPLICATIONS

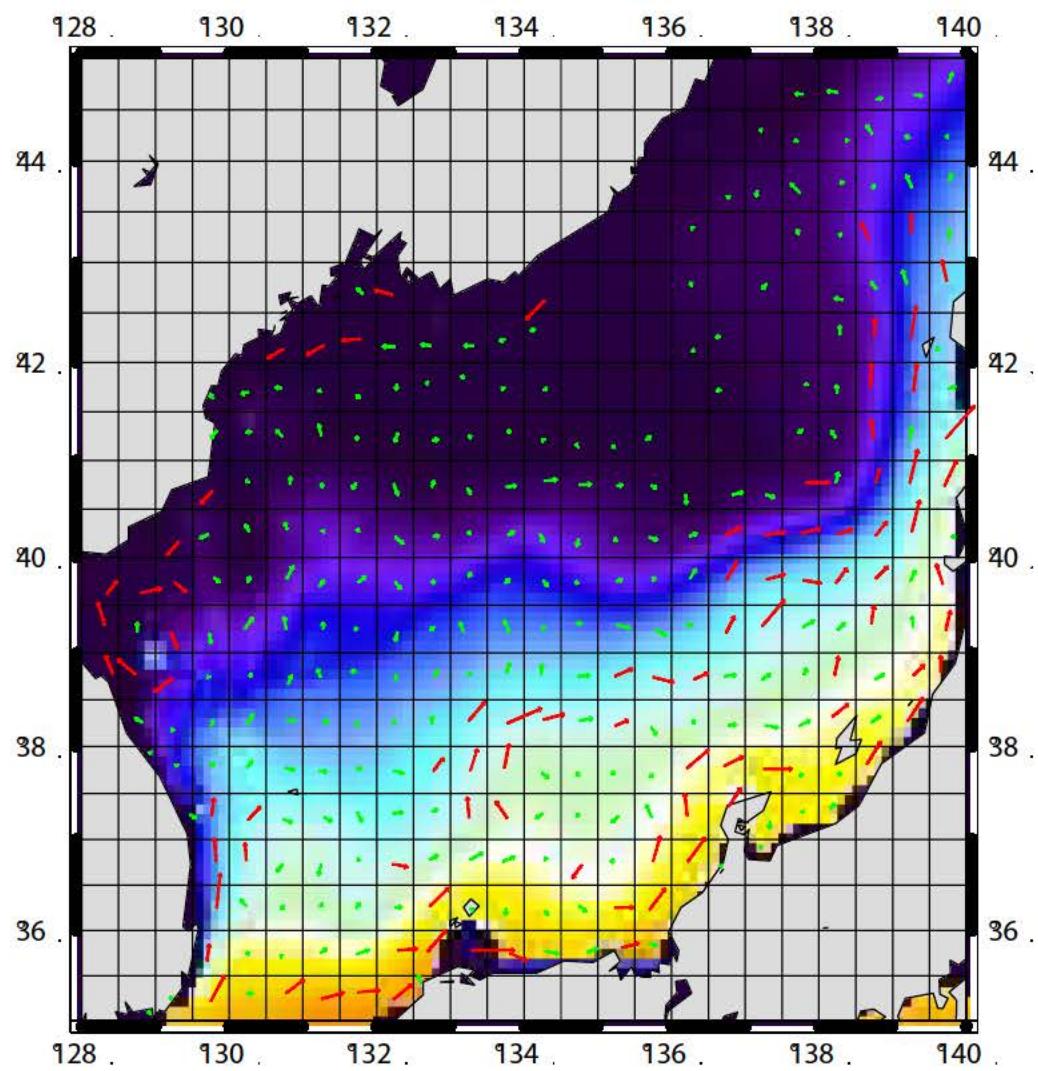
TRANSITIONS

The MINIMET drifter is available on a commercial basis. NAVOCEANO and NOAA Hurricane Center at AOML are now using these drifters in strategic operations.

RELATED PROJECTS

NOAA/OGP funded “Global Drifter Program”

Title. Temperature at 100m (Annual)



Mean) GMT 2002 Aug 22 13:10:58 mean.

Figure 1. The annual mean temperature at 100m-depth is designated by white lines and the mean drifter velocity by red arrows. These observations are overlaid on the topography of the Japan-East Sea.

Title: Eddy Conversion Rate and Growth Time (Days)

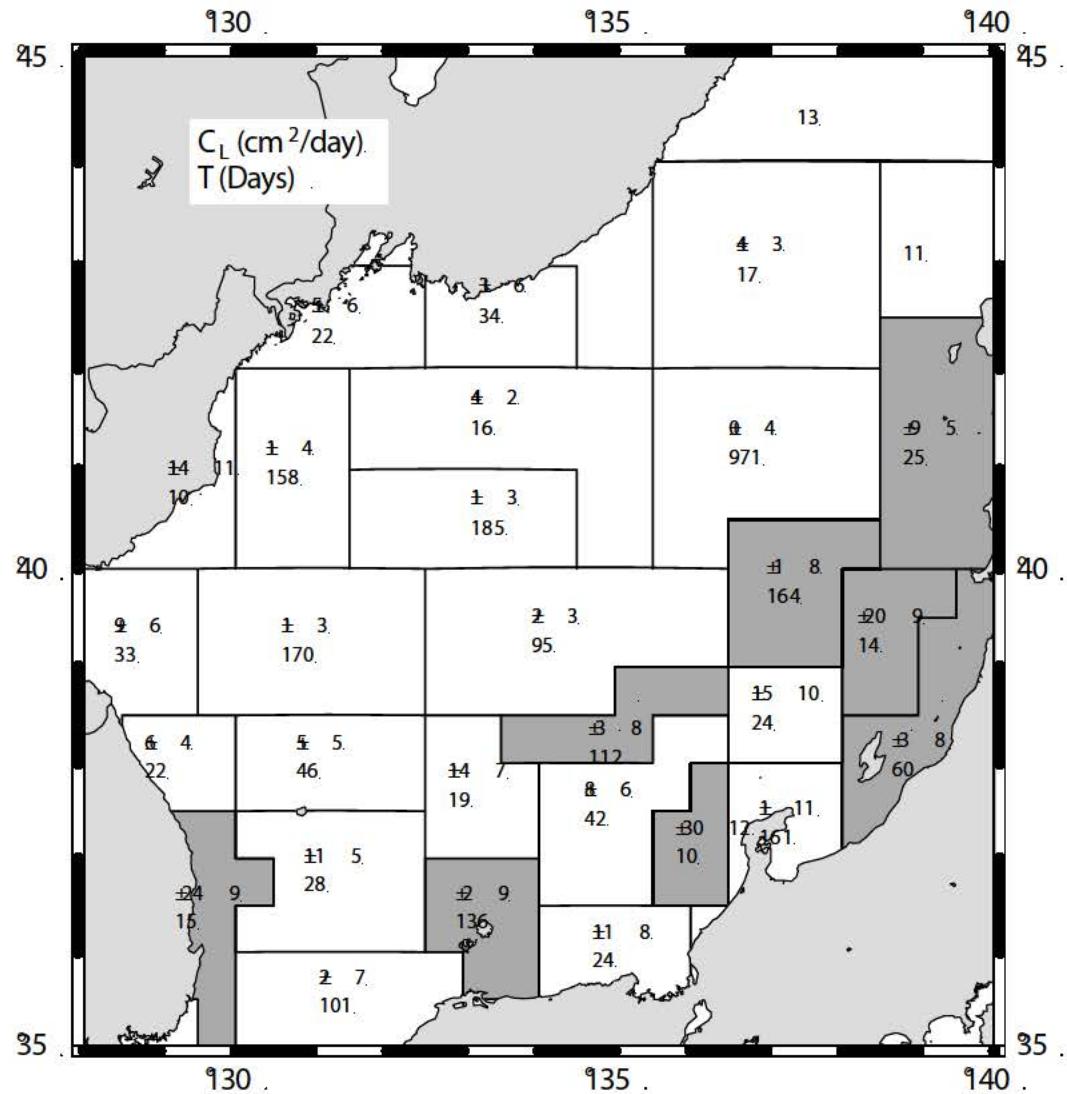


Figure 2. The energy conversion rate between the mean and the time variable motions is the upper number in units of cm²/sec²/day and the time in days for eddy energy doubling is the lower number. The shaded regions are where eddies are receiving energy from the mean flow. The computation is from the quantity [$\langle V \cdot dV/dt \rangle - \langle V \rangle \cdot \langle dV/dt \rangle$], where $\langle \rangle$ is the ensemble average and dV/dt is the Lagrangian time rate of change of velocity following the drifter motion.

Title: Drifting Buoy as Part of Mooring System



Figure 3. A thermistor chain drifter, termed ADOS, is shown placed into a small surface buoy that was be moored in the littoral zone for observations of upwelling light, winds, temperature and salinity profiles. This mooring and its sensors survived 85 KNT winds of a typhoon.

PUBLICATIONS

Hall, M.M., P.P. Niiler and W.J. Schmitz, Jr.: Mean circulation in the eastern North Pacific along 152 West. *Deep-Sea Research I*, Vol. 44, No. 7, 1137 – 1146. (1997)

Lee, Dong-Kyu, Jae-Chul Lee, and Heung-Jae Lie, A Circulation study of the East Sea using satellite-tracked drifters, *Journal of the Korean Fisheries Society*, 30, (6), Pusan, Korea. (1997)

Van Meurs, Pim and Pearn P. Niiler, Temporal variability of the large scale geostrophic surface velocity in the northeast Pacific. *J. Phys. Oceano.*, 27, 2288-2297, 1997.

Van Meurs, Pim, Interactions between near-inertial mixed layer currents and the mesoscale: The importance of spatial variabilities in the vorticity field, *J. Phys. Oceano.*, 28(7), 1363–1388. (1998)

Lee, Dong-Kyu, Pearn P. Niiler: The near-inertial energy drainage from the ocean surface to the deep layer. *J. Geophys. Res.*, Vol. 103, No C4, 7579 – 7591. (1998)

Lee, Dong-Kyu, Pearn P. Niiler, Sang-Ryong Lee, Kuh Kim, Heung-Jai Lie, Energetics of the Surface Circulation of the Japan/East Sea, *J. Geophys. Res.*, 105(C8), 19,561-19573. (2000)

Lee, Dong-Kyu, Pearn P. Niiler, Moon-Sik Suk, Comparison of Ocean Currents Observed from Drifters and TP/ERS in the East Sea, *Ocean and Polar Research*, 23(2), 133-139. (2001)

Cuny, J., P.B. Rhines, P.P. Niiler, S. Bacon: Labrador Sea Boundary Currents and the fate of the Irminger Sea Water. *J. Phys. Oceano.*, 32, 627-647. (2001)

Milliff, R.F., P.P. Niiler, J. Morzel, A.E. Sybrandy, D. Nychka and W.G. Large: Comparing observations of surface winds from NSCAT and MINIMET drifters in the Labrador Sea. (In Press: Journal of Atmospheric and Oceanic Technology, 2002)

PATENTS

None